

CLAIMS:

1. A fuel cell system, characterized by comprising:

a fuel cell (10) provided with an electrolyte membrane (11);

5 a circulation passage (28) through which a cathode off-gas discharged from a cathode (13) of the fuel cell (10) is supplied to a passage (25) for supplying an oxygen-containing gas to the fuel cell (10);

a flow control unit (50,55,56) that controls a flow of the cathode off-gas in the circulation passage (28);

10 a stop control unit (60) that stops the flow of the cathode off-gas in the circulation passage (28) by controlling the flow control unit (50,55,56) when the fuel cell system is stopped; and

15 a start-up control unit (60) that controls the flow control unit (50,55,56) after start-up of the fuel cell system until the fuel cell (10) is brought into a predetermined operation state so as to hold the flow of the cathode off-gas in the circulation passage (28) in a stopped state.

2. The fuel cell system according to claim 1, wherein:

20 the flow control unit (50,55,56) includes an inlet (51) that admits the cathode off-gas discharged from the cathode (13), a first outlet (52) to which the circulation passage (28) is connected, a second outlet (53) through which the cathode off-gas is discharged to a passage (29) other than the circulation passage (28), and a selector unit that selects between the first outlet (52) and the second outlet (53) for discharging the cathode off-gas admitted through the inlet (51);

25 the stop control unit (60) closes the first outlet (52) that has been selected by the selector unit so as to stop the flow of the cathode off-gas in the circulation passage (28); and

the start-up control unit (60) holds the first outlet (52) that has been selected by the selector unit closed so as to hold the flow of the cathode off-gas in the circulation passage (28) in the stopped state.

3. The fuel cell system according to claim 2, wherein

30 the flow control unit (50) includes an inlet (51) that admits the cathode off-gas discharged from the cathode (13), a first outlet (52) to which the circulation passage (28) is connected, a second outlet (53) through which the cathode off-gas is discharged to the passage (29) other than the circulation passage (28), and a selector valve having a valve body, which selects between the first outlet (52) and the second

outlet (53) for discharging the cathode off-gas admitted through the inlet (51);

the stop control unit (60) closes the first outlet (52) that has been selected by the selector valve so as to stop the flow of the cathode off-gas in the circulation passage (28); and

5 the start-up control unit (60) holds the first outlet (52) that has been selected by the selector valve closed so as to hold the flow of the cathode off-gas in the circulation passage (28) in the stopped state.

4. The fuel cell system according to claim 2, wherein:

10 the flow control unit includes the inlet (51) that admits the cathode off-gas discharged from the cathode (13), the first outlet (52) to which the circulation passage (28) is connected, the second outlet (53) through which the cathode off-gas is discharged to the passage (29) other than the circulation passage (28), a first switching valve (55) that allows the cathode off-gas admitted through the inlet (51) to flow into the first outlet (52), and a second switching valve (56) that allows the cathode off-gas
15 admitted through the inlet (51) to flow into the second outlet (53);

the stop control unit (60) closes the first switching valve (55) so as to stop the flow of the cathode off-gas in the circulation passage (28); and

20 the start-up control unit (60) holds the first switching valve (55) closed so as to hold the flow of the cathode off-gas in the circulation passage (28) in the stopped state.

5. The fuel cell system according to any one of claims 1 to 4, wherein:

the operation state of the fuel cell (10) comprises an amount of water contained in the electrolyte membrane (11); and

25 the start-up control unit (60) holds the stopped state of the flow of the cathode off-gas until the amount of water becomes equal to or smaller than a predetermined amount.

6. The fuel cell system according to any one of claims 1 to 4, wherein:

the operation state of the fuel cell (10) comprises an operation temperature of the fuel cell (10); and

30 the start-up control unit (60) holds the stopped state of the flow of the cathode off-gas until the operation temperature becomes higher than a predetermined temperature.

7. The fuel cell system according to claim 6, wherein the start-up control unit (60) executes a start-up control based on a predetermined map such that a

circulation amount of the cathode off-gas becomes zero when the operation temperature is equal to or lower than the predetermined temperature.

8. The fuel cell system according to any one of claims 1 to 4, wherein:
the operation state of the fuel cell (10) comprises a total power
5 generation amount accumulated from the start-up of the fuel cell (10); and
the start-up control unit (60) holds the stopped state of the flow of the
cathode off-gas until the total power generation amount exceeds a predetermined
amount.

9. The fuel cell system according to any one of claims 1 to 4, wherein:
10 the operation state of the fuel cell (10) comprises an elapsed time from
the start-up of the fuel cell (10); and
the start-up control unit (60) holds the stopped state of the flow of the
cathode off-gas until the elapsed time reaches a predetermined time.

10. The fuel cell system according to any one of claims 1 to 4, wherein:
15 the operation state of the fuel cell (10) comprises a hydrogen
consumption amount obtained from the start-up of the fuel cell (10); and
the start-up control unit (60) holds the stopped state of the flow of the
cathode off-gas until the hydrogen consumption amount reaches a predetermined
amount.

20 11. The fuel cell system according to any one of claims 1 to 4, wherein the
stop control unit (60) executes a stop control based on an outside temperature.

12. A method of operating a fuel cell system characterized by comprising:
supplying an oxygen-containing gas to a fuel cell (10) provided with
an electrolyte membrane (11);
25 circulating a cathode off-gas discharged from a cathode (13) of the fuel
cell (10) to a passage (25) through which the oxygen-containing gas is supplied;
stopping a circulation of the cathode off-gas when the fuel cell system
is stopped; and
holding the circulation of the cathode off-gas in a stopped state until
30 the fuel cell (10) is brought into a predetermined operation state after start-up of the
fuel cell system.